

UNIVERSITY OF ILLINOIS  
AT URBANA-CHAMPAIGN

Office of the Provost and Vice Chancellor  
for Academic Affairs

Swanlund Administration Building  
601 East John Street  
Champaign, IL 61820



October 5, 2001

Susan A. Lamb, Chair  
Senate Committee on Educational Policy  
Office of the Senate  
228 English Building, MC-461

Dear Professor Lamb:

Enclosed are copies of a proposal from the College of Engineering for a Biomaterials Concentration for the BS in Materials Science and Engineering.

This proposal has been approved by the College of Engineering Executive Committee and Engineering Faculty; it now requires Senate review.

Sincerely,

A handwritten signature in black ink, appearing to read 'Keith A. Marshall'.

Keith A. Marshall  
Assistant Provost

KAM/drm

c: C. Livingstone  
M. Spong  
D. Daniel  
J. Weaver  
D. Leckband  
D. Padua  
B. Trimble

UNIVERSITY OF ILLINOIS  
AT URBANA-CHAMPAIGN

EP.02.16

College of Engineering  
Executive Committee  
306 Engineering Hall, MC-266  
1308 West Green Street  
Urbana, IL 61801



September 18, 2001

Keith Marshall  
207 Swanlund Administration Building  
MC-304

Dear Mr. Marshall:

The College of Engineering Executive Committee and the Faculty of the College of Engineering have reviewed and approved the following new area of concentration in the Department of Materials Science and Engineering:

**Biomaterials for the BS in Materials Science and Engineering**

Enclosed is the original and 25 copies of the request.

Sincerely yours,

Mark W. Spong, Secretary  
Executive Committee

Approval Recommended:

D. E. Daniel, Dean  
College of Engineering

9/18/01  
Date

Enclosure

cc: J. Weaver  
D. Leckband  
D. Padua  
B. Trimble

Minor Curriculum Revision Approval

## PROPOSAL TO THE SENATE COMMITTEE ON EDUCATIONAL POLICY

### TITLE OF THE PROPOSAL

New area of concentration (Biomaterials) for the BS in Materials Science and Engineering, College of Engineering.

### SPONSER

Department of Materials Science and Engineering  
Contact: P. H. Geil (333-0149)

### BRIEF DESCRIPTION

Since its formation in 1987 by the merger of the Metallurgy and Ceramics Engineering departments, students in the Department of Materials Science and Engineering have been able to specialize (have concentrations) in four designated areas: ceramics, electronic materials, metallurgy and polymers. In addition they were given the option to design their own concentration, with advisor approval, as long as the program met certain requirements; suggested were possible concentrations in biomaterials or composites. With the addition of several faculty to the department with primary research interest in the area and related research by additional faculty, and with increasing student demand, we now propose to formalize the biomaterials concentration as the 5<sup>th</sup> concentration in the Department with a defined program of study.

The present curriculum for the BS in MATSE is structured with a block of MATSE core courses on the science of materials that rests on a foundation of math, physical and engineering sciences courses. This is followed by options that require the student to apply these principles to the science and engineering of various types of materials with, currently, defined programs for our four concentrations; the proposal is to add a fifth retaining the foundation.

The new biomaterials concentration, attached, requires some changes in the core MATSE curriculum because of the need to incorporate courses in the biological sciences and the study of living structures. This will be done without changing the math, physical science and engineering science courses taken by all MATSE students in the first two years. The curriculum also includes 18 semester hours of Social Sciences and Humanities and 6 semester hours of free electives. The campus requirement in advanced composition is fulfilled, as for our other MATSE students, by the required course MATSE 207 and 208, MATSE LAB I and II. There will be no change in the graduation requirement of 128 semester hours. However, the following changes are proposed for the junior and senior years:

1. Some of the MATSE core courses formerly required of all students will be replaced by courses in life science. Students will take CHEM 231, Organic Chemistry; BIOCH 350, Intro to Biochemistry; MCB 150, Molecular and Cellular Basis of Life; MCB 252, Cells, Tissues and Development instead of MATSE 204, Electronic Properties of Materials; MATSE 303, Synthesis of Materials and MATSE 305, Microstructure Characterization.
2. Three new required senior level courses have been approved by the Engineering and Graduate Colleges: MATSE 370, Design and Application of Biomaterials; MATSE 372, Biomaterials Laboratory and MATSE 373, Biomolecular Materials Science. Course descriptions may be reviewed in the Senate Office.
3. A new selection of technical electives is provided to complement the lists for the other concentrations.

4. Two MATSE courses (6 semester hours) must be taken from the lists of courses approved for the other four areas of concentration in the department.

The Chief Advisor of the Department assigns each new student enrolled in the Department to a Undergraduate Faculty Advisor within the Department, with the students being given the option, when they chose their concentration, to add or replace the assigned Advisor with another Faculty Advisor whose research interests are in their chosen area.

### **JUSTIFICATION**

The addition of this new concentration, in addition to responding to student demand, is responsive to the stated directives for new campus programs in biotechnology. It will prepare our students for exciting and rewarding careers in a rapidly developing area of Materials Science and Engineering.

### **BUDGETARY AND STAFF IMPLICATIONS**

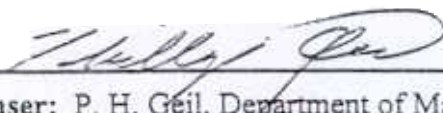
- a. **Additional staff and dollars needed.** The department currently has two faculty with primary research interests in the area of biomaterials, Profs. R. Jamison and G. Wong. At least 7 other faculty have research projects or interests in the area. Recognizing the growing importance of the area the department has dedicated one of its current faculty openings to the addition of another person with primary interest in the area. It is believed this will give the department adequate personnel to teach the needed MATSE courses. No additional new dollars are requested.
- b. **Internal reallocations.** There are no expected changes in class size in the department, except in remaining required MATSE core courses. It is anticipated the new concentration will draw 10-20 new students annually to the department.
- c. **Effect on other departments.** The addition of our students to the CHEM 231 course is expected to have minimal impact since they would constitute only a small fraction of the enrollment. MCB 150 and 252 are new courses, currently restricted to students in the Biological Sciences program. Prof. D. Raineri, Associate Director for Undergraduate Instruction and Instructional Technology, School of Molecular and Cellular Biology, has agreed that our Biomaterials concentration students will be accepted starting in 2002
- d. **Impact on library, computer, laboratory, etc use.** No impact on the library is expected; all potentially needed journals and reference materials are already available. The department maintains its own computer facilities, upgraded this year with the gift of 20 1GHz Pentium 4 machines by Intel. An undergrad biomaterials laboratory is being equipped with department and alumni funds. Sufficient equipment is available to initiate MATSE372, with additional being solicited from industry and alumni.

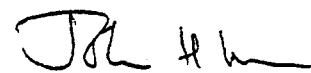
### **GUIDELINES FOR UNDERGRADUATE EDUCATION**

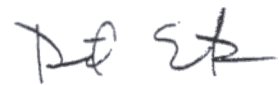
The new concentration remains consistent with the spirit and intent of the Vice-Chancellors statement of guidelines for undergraduate education. The MATSE program has in the past and will continue to emphasize a broad training in the various areas of materials science and engineering in response to guideline # 3 as well as meeting guidelines 1 and 2; the stated educational objectives of the department are as follows:

1. To provide students with the necessary foundation for entry-level industrial positions in materials related industries or advanced study programs by a comprehensive education that includes in-depth instruction in both materials as a whole and in their chosen concentration, with an emphasis on analysis, problem solving, exposure to open-ended problems, and design methods.
2. To provide students with an introduction to team work, communication techniques, and individual professionalism, including ethics and environmental awareness, to prepare them for advanced study programs and successful, productive careers in industry.
3. To provide students with the opportunity to broaden their education in engineering and science or expand their knowledge in a particular technical area by offering a choice of technical and free electives. To provide students with the opportunity to participate in the co-operative education and study abroad programs.
4. To provide students with opportunities to learn and grow as individuals, to contribute to society, and to appreciate the ability to achieve their goals through life-long learning and leadership.

**CLEARANCES**

 5/30/01  
 \_\_\_\_\_  
 Sponsor: P. H. Geil, Department of Materials Science and Engineering      date

 8/21/01  
 \_\_\_\_\_  
 Department Head: J. H. Weaver, Dept. of Materials Science and Engineering      date

 9/18/01  
 \_\_\_\_\_  
 Dean: D. E. Daniel, College of Engineering      date

**STATEMENT FOR PROGRAMS OF STUDY CATALOG**

See attached

**EFFECTIVE DATE**

January 1, 2002

## Statement for the Bulletin

### Curriculum in Materials Science and Engineering

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Department of Materials Science and Engineering  
201 Metallurgy and Mining Building  
1304 West Green Street  
Urbana, IL 61801  
(217) 333-1441  
Fax: (217) 333-2736  
URL: <http://www.mse.uiuc.edu>

#### For the Degree of Bachelor of Science in Materials Science and Engineering

#### What is Materials Science and Engineering?

Materials Science and Engineering teaches how to make the materials that serve as the basis for all technologies. Students learn how to design advanced materials ranging from better polymers for synthetic fabrics and ceramic-metal composites for jet engines, to advanced thin films for microelectronics and biocompatible materials for implants in the body. The curriculum uses both basic physics and chemistry concepts and provides a detailed knowledge of what makes the materials we use every day respond as they do. Students in the first two years take courses in general areas of science and engineering as well as courses introducing the concepts in MatSE. The curriculum is designed to allow relatively easy transfer to and from other Engineering disciplines within the first two years. In the third year, students study the central issues related to MatSE in general. Seniors focus on application areas of MatSE which provide them the detailed knowledge to be immediately useful to corporations or to provide an introduction to graduate study. This degree program is designed to be completed in eight semesters of study with no advanced placement credit. The MatSE degree requires a minimum of 128 hours for graduation and is consistent with the professional component described in the introduction for the college. The program has been ABET accredited. Formal statements of the mission of the department and the goals of the undergraduate program as well as further details may be found at <http://www.mse.uiuc.edu/info/msedegree.html>.

#### Application Areas

The MatSE program provides five standard focus areas as well as the option to design unique programs of interest to the student. Students are encouraged to take technical electives outside of the department in related disciplines of interest to them and of relevance to their career goals.

- **Ceramics:** Students study the science and engineering of ceramic materials including alloy design, composites, synthesis and processing methods. This area makes significant use of concepts from both basic physics and basic chemistry.
- **Metals:** Introduces the design and processing of metals and alloys to achieve desired properties. This area primarily uses concepts from basic and intermediate physics with relatively less emphasis on chemical concepts.
- **Polymers:** Teaches the methods for molecular design to achieve desired properties in polymer molecules and polymer blends as well as processing methods. This area primarily

uses concepts from basic and intermediate chemistry with relatively less emphasis on physics concepts.

- **Electronic Materials:** Describes the design and engineering of materials primarily for the microelectronics industries. Topics span the ceramics, metals, and polymers areas. Concepts from basic and intermediate physics are used along with basic chemistry.
- **Biomaterials:** A new focus area teaching the science and engineering of materials for use in biological applications, particularly in the human body. This area uses a strong focus on basic and intermediate chemistry along with basic and intermediate biology concepts with relatively little use of physics topics. This focus area includes a subset of the standard junior year courses and requires additional chemistry and biology in the junior year.

## **Educational Objectives**

The educational objectives of the MatSE Department are:

- To provide the foundation for entry level industrial positions in materials-related industries or advanced study programs through in-depth instruction in both materials as a whole and in their chosen concentration. An emphasis is placed on analysis, problem solving, open-ended problems and materials design methods.
- To develop teamwork, communication skills and individual professionalism, including ethics and environmental awareness.
- To encourage students to broaden their education in engineering and science or expand their knowledge through student-selected technical and free electives, and Co-op, internship and Study Abroad programs.
- To teach students to learn and grow as individuals, contribute to society and to develop life-long learning and leadership skills.

## **Educational Outcomes**

It is expected that the graduates will have:

- An ability to apply knowledge of mathematics, science, and engineering principles to materials systems..
- An integrated understanding of the materials science and engineering principles underlying the interrelationships between structure, properties, processing, and performance of materials and material systems appropriate to their field
- An ability to apply the knowledge obtained above to identify, formulate, and solve engineering and design problems involving application and selection of materials..
- Familiarity or experience with modern techniques, instrumentation and other tools required for experimental and engineering design, data collection, and data analysis in the practice of materials science and engineering.
- An ability to design, conduct, analyze, and interpret results of laboratory experiments (including statistical and computational methods) involving the behavior of materials in applications
- An ability to work in and provide leadership for teams in the solution of science and engineering problems
- An ability to communicate effectively through written reports and oral presentations
- The broad education necessary to understand the impact of materials engineering problems and solutions in a global/societal context
- An understanding of professional and ethical responsibilities and their implications.
- A recognition of the need for and an ability to engage in life-long learning

A knowledge of contemporary issues in the context of engineering problems in materials science and engineering

### **Job Opportunities**

MatSE graduates work with engineers across the spectrum of design and manufacturing. They design the materials that make the technologies we rely on work better. Our graduates work as parts of teams designing high technology devices. They move on to management. They get advanced degrees and work as teachers and bench scientists. MatSE graduates work for all types of engineering and technology companies ranging from small businesses to huge corporations, in all materials related areas. Starting salaries are among the highest in Engineering. All companies that manufacture mechanical, electronic or other devices can benefit from staff members with a strong understanding of materials. MatSE students also go on to graduate school in science, engineering, medicine, and business .



## . Materials Science and Engineering Curriculum:

### First year

#### HOURS FIRST SEMESTER

3	CHEM 101-General Chemistry
1	CHEM 105-General Chemistry Laboratory
0	ENG 100-Engineering Lecture
5	MATH 120-Calculus and Analytic Geometry, I <sup>1</sup>
(1)	MATSE 100-Materials Lecture <sup>2</sup>
4	RHET 105-Principles of Composition
3	Elective in social sciences or humanities <sup>3</sup>
16	Total

#### HOURS SECOND SEMESTER

3	CHEM 102-General Chemistry (Biological or Physical Version)
1	CHEM 106-General Chemistry Laboratory (Biological or Physical Version)
3	MATH 130-Calculus and Analytic Geometry, II
2	MATH 225--Introductory Matrix Theory
3	MATSE 182-Introduction to Materials Science and Engineering
4	PHYCS 111--General Physics (Mechanics)
16	Total

### Second year

#### HOURS FIRST SEMESTER

3	C S 101-Introduction to Computing with Application to Engineering and Physical Science
3	MATH 242-Calculus of Several Variables
3	MATSE 201-Phases and Phase Relations
4	PHYCS 112--General Physics (Electricity and Magnetism)
3	Electives in social sciences or humanities <sup>3</sup>
16	Total

#### HOURS SECOND SEMESTER

3	ECE 205--Introduction to Electric and Electronic Circuits
3	MATH 285--Differential Equations and Orthogonal Functions
2	PHYCS 114-General Physics (Wave and Quantum Physics)
4	T A M 206-Mechanics of Materials and Fluids
3	Elective in social sciences or humanities <sup>3</sup>
15	Total

### Third year

#### HOURS FIRST SEMESTER

3	I E 230-Analysis of Data
3	MATSE 207-Materials Science and Engineering Lab, I <sup>4</sup>
4	MATSE 301 /CHEM 245- Thermodynamics of Materials
3	MATSE 305—Microstructure Characterization
3	Synthesis of Materials
16	Total

#### HOURS SECOND SEMESTER

3	MATSE 204-Electronic Properties of Materials
3	MATSE 208-Materials Science and Engineering, Lab II <sup>4</sup>
3	MATSE 302-Kinetic Processes in Materials
3	MATSE 306-Thermal-Mechanical Behavior of Materials
3	Division specialty course <sup>5</sup>
3	Elective in social sciences or humanities <sup>3</sup>
18	Total

### Fourth year<sup>6</sup>

#### HOURS FIRST SEMESTER

3	Technical elective <sup>7</sup>
3	Division specialty course <sup>5</sup>
3 (4)	Division specialty course <sup>5</sup> (or Senior Lab) <sup>8</sup>
3	Free elective
3	Electives in social sciences or humanities <sup>3</sup>
15(16)	Total

#### HOURS SECOND SEMESTER

3	Division specialty course <sup>5</sup>
4 (3)	Senior Lab <sup>8</sup> or division specialty course <sup>5</sup>
3	Technical elective <sup>9</sup>
3	Elective in social sciences or humanities <sup>3</sup>
3	Free elective
16(15)	Total

1. It is recommended that freshmen with appropriate background in analytical geometry take the MATH 135, 245 calculus sequence, delaying MATH 225 until the sophomore year, instead of MATH 120,130, 242.
2. This course is highly recommended for freshmen who may use it to help meet free elective requirements.
3. Each student must satisfy the social sciences and humanities requirements of the College of Engineering and the campus general education requirements for social sciences and humanities.
4. Satisfies the general education Compositional requirement.
5. To be selected from the list of division specialty courses as established by the department to provide an acceptable level of study in the student's chosen area of specialization. One of these selections in the senior year must be from the following capstone design courses: MATSE 322, 343, 353, 362 and .370.
6. It is recommended that students who intend to continue in graduate school undertake a research project in the senior year.
7. Selected from the departmental list of approved technical electives, which is available from the department.
8. This course includes an independent study.
9. Selected outside the area of concentration from departmental list of approved technical electives.

### **Area Specialty Courses (including Senior Lab):**

The courses listed below have been approved by the department to satisfy the requirements in each of the five areas of technical specialization. Each area of specialization requires at least one course covering each of the topics processing, design, and characterization (laboratory) together with suitable electives. Students wishing to pursue other areas of specialization not listed should consult with their academic adviser or the chief adviser for the department. Such customized programs require the approval of the department.

<b>HOURS</b>	<b>CERAMICS CONCENTRATION</b>
3	MATSE 320 Ceramics Materials and Properties
3	MATSE 321 Ceramic Processing and Microstructure Development
3	MATSE 322 Process Design
4	MATSE 323 Ceramic Engineering Processing Laboratory
<b>HOURS</b>	<b>ELECTRONIC MATERIALS CONCENTRATION</b>
3	ECE 340 Solid State Electronic Devices
3	MATSE 360 Electronic Materials and Processing I
3	MATSE 361 Electronic Materials and Processing II
4	MATSE 362 Electronic Materials Laboratory
<b>HOURS</b>	<b>METALS CONCENTRATION</b>
3	MATSE 340 Advanced Mechanical Properties of Solids

3 MATSE 341 Metals Processing  
4 MATSE 342 Metals Laboratory  
3 MATSE 343 Design of Engineering Alloys

**HOURS POLYMERS CONCENTRATION**

3 MATSE 350 Introduction to Polymer Science and Engineering  
3 MATSE 353 Plastics Engineering  
4 MATSE 352 Polymer Laboratory  
3 Division Technical Elective

**HOURS BIOMATERIALS CONCENTRATION**

3 CHEM 231 Organic Chemistry  
(Replaces MATSE 303)  
3 MCB 150 Molecular & Cellular Basis of Life  
(Replaces MATSE 305)  
3 MCB 252 Cells, Tissue, and Development  
(Replaces MATSE 204)  
3 BIOCH 350 Introduction to Biochemistry  
3 MATSE 370 Design & Applic. of Biomaterials  
1 MATSE 372 Biomaterials Laboratory  
3 MATSE 373 Biomolecular Materials Science  
3 Elective in a different MATSE concentration  
(plus one of the technical electives should be in the  
same concentration)

*Semesters 1-4* Same as current MATSE undergraduate curriculum (63 semester hours).

*Semester 5 - Junior*

Course No.	Course Title	Credits	Remarks
MATSE 301	Thermodynamics of Materials	4	
MATSE 207	MATSE Lab I	3	
CHEM 231	Elementary Organic Chemistry	3	
IE 230	Analysis of data	3	
	Elective in social sci./humanities	3	
Semester total		16	

Course No.	Course Title	Credits	Remarks
MATSE 302	Kinetic Processes in Materials	3	
MATSE 306	Thermal-Mechanical Behavior	3	
MATSE 208		3	
	Molecular & Cellular Basis of Life	3	
BIOCH 350	Introduction to Biochemistry	3	
	Free elective	3	
Semester total		18	

*Semester 7 – Senior*

Course No.	Course Title	Credits	Remarks
MATSE 370	Design & Application of Biomat'ls	3	New course
MATSE 372	Biomaterials Lab	1	New course
MATSE xxx	Elective in MATSE	3	footnote #1
	Technical elective	3	footnote #2
	Elective in social sci./humanities	3	
	Free Elective	3	
Semester total		16	

*Semester 8 - Senior*

Course No.	Course Title	Credits	Remarks
MATSE 373	Biomolecular Materi	3	New course
MCB 252	Cells, Tissue and Development	3	
MATSE xxx	I	3	footnote #1
		3	
	Elective in social sci./humanities	3	

15

**CURRICULUM TOTAL: 128**

Technical Electives for the Biomaterials Concentration

Course No.	Course Title	Credits	Remarks
BIOPH 301	Introduction to Biophysics	3	
ECE 280	Biomedical Imaging	3	
ECE 315	Biomedical Instrumentation	3	
	Molecular Genetics	3	
			footnote #1

**Footnotes**

1. Additional elective courses will be developed by new and current MATSE faculty members.